Sustainability
at Idaho's National Laboratory

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Idaho National Laboratory

An account of INL's efforts to advance the interests of sustainability for Idaho and the nation

FALL 2010

Operations at the Materials and Fuels Complex support INL's mission to "ensure the nation's energy security with safe, competitive, and sustainable energy systems and unique national and homeland security capabilities."

A promise to future generations

The author's personal view —

One of the benefits of living in an open, democratic society is that our government is ultimately accountable to the people. But who are the people to whom this accountability is owed?

From the standpoint of legally enforceable accountability, the people are those currently within the community and subject to government jurisdiction. Under a broader concept of accountability, however, our understanding of who the people are expands forward to people in future generations and outward to people in other communities. These two dimensions of moral accountability — generational and global — create difficult dilemmas that must be addressed by energy policy.

With leadership comes an elevated level of responsibility, including an ethical responsibility …

From a moral perspective, meeting the energy needs of this generation should not deprive subsequent generations of the opportunity to meet their own energy needs. Similarly, albeit more controversially, if one community, state or nation meets its energy needs with a policy that deprives other communities of the opportunity to meet their needs, conflict eventually will result. The conflict may be resolved by subjugation (with economic and human costs) or by negotiation (with compromises and changes in the policy). In each scenario, the underlying issue is sustainability.

Energy policy becomes unsustainable when it cannot be applied forward to multiple generations or across multiple communities. Policies that promote consumption of energy sources faster than they can be replenished are not sustainable.

As a result, there is an increasingly urgent search for more sustainable sources of energy, such as nuclear energy.

Don Burnett is the dean of the University of Idaho College of Law. His career encompasses service as an appellate judge, practicing lawyer, state bar president and dean and teacher of law. Born in Pocatello in 1946, he received a baccalaureate degree magna cum laude in economics from Harvard University, a juris doctor degree from the University of Chicago and a master of law degree from the University of Virginia. He also graduated on the Commandant's List from the Command and General Staff College of the U.S. Army. His scholarly and teaching interests include ethics and professional responsibility. This article reflects his personal views.

Sustainability's promise … Continued on page 2

A discussion with INL director John Grossenbacher

John Grossenbacher is the director of Idaho National Laboratory and president of Battelle Energy Alliance, LLC (BEA). His credentials and experience include leadership and management of large institutions with substantial efforts focused on technology research and development. Before joining Battelle, he had a distinguished career with the U.S. Navy, achieving the rank of vice admiral and commander of the U.S. Naval Submarine Forces. He earned a bachelor's degree in chemistry from the U.S. Naval Academy, a master of arts degree in international relations from The Johns Hopkins University and completed the Graduate School of Business Administration program for management development at Harvard University.

On INL's contribution to the sustainability of nuclear energy

Nuclear energy is an enormously important resource for the world. With the technology we have today, the world can rely on nuclear energy for hundreds if not thousands of years with acceptable environmental impact. INL continues developing, demonstrating and deploying nuclear technology because it is in both the national and global interest.

On past and present environmental practices

What people may not understand is how differently the lab operates today compared to its early days. When nuclear technology was getting its start here in Idaho, the answer to pollution was dilution. Keeping hazardous materials in remote locations away from people was accepted as the way to dispose of them. The wastes that were generated or shipped here were buried in the desert.

People forget that when those sins of the past were committed, there was no Environmental Protection Agency and there were very few rules governing environmental practices. In hindsight, those environmental sins were costly. We have cleaned up or mitigated many of the challenges left over from the early days. We don't do business that way anymore.

On the laboratory's ongoing environmental compliance

Today, we manage our waste and the associated risks with much greater care and transparency. Given our mission, it is reasonable for the public to hold INL to the highest standards. In turn, we think it is important to be open about our environmental practices so the public has confidence that we're meeting those standards. We welcome competent, responsible scrutiny. It validates our commitment to environmental stewardship.

A few years back, we spilled some diesel fuel. It turns out that it all collected in a trench and was readily cleaned up. We work with much more hazardous materials than diesel fuel. So, even though it was a minor environmental issue, the public has a right to ask, "If they can't keep diesel fuel in the pipes, why should we trust them with radioactive material and nuclear reactors?" Obviously, there is a difference between managing diesel fuel and nuclear reactors.

Nevertheless, compliance with the highest environmental protection standards is essential. That is why we aim beyond the letter of the law to meet the intent of the law. Our practices in all aspects of our work must be exemplary. Our mission, as well as the need to maintain public trust and confidence, demands that we operate to the highest of standards.

On the global demand for energy

Modern society has chosen a quality of life that is very energy dense and we live in an increasingly energy-hungry world. Energy use offers significant benefits, but it also comes with costs, risks and environmental impacts.

The U.S. has an important leadership role in meeting the rising global demand for energy. We have to lead in providing practices and technologies that reduce the environmental impacts of energy production, distribution and consumption. And, we have to support more long-term sustainable use of our energy resources.

Because no energy is free, we should discipline ourselves to use it efficiently and to good purpose. We should get as much as we practically and economically can out of

Discussion with INL director … Continued on page 7

Sustainability at INL – A philosophy practiced daily

INL is committed to carrying out its mission of ensuring the nation's energy security without compromising the ability of future generations to meet their own needs. INL's efforts are focused on three broad components of sustainability — environmental, economic and social — to protect and enhance natural resources so future generations can enjoy a quality of life that is equal to or greater than our own.

Environmental sustainability

A key component of INL's sustainability program is protecting the environment. Compliance with environmental laws and following best management practices are critical for sustainability, but INL also encourages resource conservation and waste prevention. INL uses E85 (ethanol-based fuel) for government vehicles and is reducing fleet fuel consumption, increasing waste recycling, conserving water and making facilities more energy efficient.

Economic sustainability

INL is a multiprogram laboratory, which means its funding comes from multiple programs within DOE as well as other governmental agencies. This diversity helps the laboratory remain economically sustainable. In return, INL supports local, state and regional businesses through its small business and economic development programs and its technology transfer efforts encourage business growth and U.S. technology competitiveness.

Social sustainability

As a research organization, INL depends on a well-educated and diverse work force. In return, INL seeks to be a responsible employer and outstanding member of the community by providing a safe, healthy environment for workers and by encouraging workers to participate in the betterment of the community and world.

LEEDing by example – CAES facility is gold-certified

INL supports high-performance green facilities that advance our research mission while considering the needs of people, the planet and prosperity. The 55,000-square-foot building for the Center for Advanced Energy Studies (CAES) is an excellent example of this commitment.

With INL support, the Idaho State University facility was designed and built to meet Leadership in Energy & Environmental Design (LEED) standards. LEED is an internationally recognized certification system that rates buildings on criteria such as water efficiency, stewardship of resources, carbon dioxide emissions reduction, indoor air quality and energy savings.

The CAES building is LEED Gold-certified, the second highest rating and just one of a handful of certified buildings in Idaho; the others are located in the Boise and Hailey areas.

The Center for Advanced Energy Studies is located in a high-performance building that reduces negative environmental impacts and improves the health and well-being of the occupants.

Water efficiency

At the CAES facility, water is conserved and recycled as much as possible. The facility uses dual-flush toilets and water-efficient urinals, faucets and showerheads. Instead of draining into the Idaho Falls water drainage system, stormwater drains into bioswales that naturally clean the water and let it percolate into the ground. Irrigation is minimized by using native, drought-tolerant vegetation, but when it is required, water is drawn from the heating, ventilation and air-conditioning system. Overall, the facility uses 45 percent less water than a building of similar size.

Stewardship of resources

Recycled materials were used extensively throughout the facility. The structural system, for example, was constructed primarily with recycled steel. The building provides abundant daylight and 90 percent of the occupants have a outdoor view. At night, the exterior light fixtures preserve the view of the nighttime sky. All of the occupants can control the ventilation system so they have clean, fresh air. Indoor air quality is preserved by using furniture certified to not emit dangerous chemicals, such as formaldehyde or volatile organic compounds.

Leadership in Energy & Environmental Design (LEED) is an internationally recognized green building certification system.

Energy savings

The facility consumes an estimated 38 percent less energy than the levels established by the American Society of Heating, Refrigerating and Air-Conditioning Engineers code. The building's energy efficiency is estimated to reduce electricity costs by 32.3 percent and natural gas costs by 47.8 percent, with an estimated annual savings of nearly $68,000.

"It's absolutely fitting that a facility dedicated to energy studies is also a green building," said Jennifer Morton, INL Pollution Prevention Program. "CAES is an excellent outcome of INL's commitment to using high-performance buildings."

Promise … Continued from page 1

Commercial nuclear energy originated with reactors built in Idaho primarily during the 1950s and '60s. I grew up in eastern Idaho during those years and well remember the pioneering efforts at the old Atomic Energy Commission site. Today, nuclear energy powers one of every five light bulbs in our country and provides a substantial share of energy for the world. The nuclear technology that began in Idaho is now prominent worldwide.

As Idahoans, we can — and should — be proud of our technological leadership. With leadership comes an elevated level of responsibility, including an ethical responsibility, a precept now taking its place alongside science and engineering in shaping the work of INL.

What is this ethical responsibility? Immediate and obvious to Idahoans, the laboratory must be a responsible neighbor. That means cleaning up after itself and managing wastes in a manner that protects the health of workers, nearby inhabitants and the environment. The U.S. Department of Energy (DOE) is bound by, and acknowledges its obligation to comply with, environmental laws. DOE also is undertaking to restore the environment surrounding INL facilities. These are positive steps.

As the laboratory addresses problems that are legacies of the past, however, it should also shape the future by discovering new ways to develop renewable energy and by identifying best practices for achieving the long-term goal of sustainability.

The term "sustainability" occasionally attracts controversy in political discourse, but it illuminates INL's bright future. It also expresses an ethical precept that is finding its way into standards of professional conduct. The National Society for Professional Engineers, for example, has incorporated the precept into its code of ethics: "Engineers shall at all times strive to serve the public interest [and] are encouraged to adhere to the principles of sustainable development in order to protect the environment for future generations." We should applaud the spirit of this statement. We should similarly expect INL to reinforce the ethical standard of sustainability at the institutional level by implementing every word of its assigned mission: "Ensure the nation's energy security with safe, competitive, and sustainable energy systems and unique national and homeland security capabilities."

This is a high calling and worthy challenge. It summons forth the best leadership Idaho can offer to the nation and the world at the intersection of technology and ethics.

The Advanced Mixed Waste Treatment Project has sharply reduced the amount of transuranic waste once stored at DOE's Idaho Site by examining, treating and shipping it 1,300 miles to its final destination at the Waste Isolation Pilot Plant, near Carlsbad, N.M.

Shipping waste out of Idaho

Few projects in the DOE complex can match the cleanup achievements of the employees at DOE's Advanced Mixed Waste Treatment Project (AMWTP). Managed and operated by Bechtel BWXT Idaho (BBWI) since May 2005, AMWTP is a modern and effective radioactive waste treatment facility located at DOE's Idaho Site. The project has enabled DOE to meet its 1995 Idaho Settlement Agreement commitments to ship transuranic radioactive waste out of Idaho. Nearly all of the transuranic waste treated at and shipped from AMWTP was received in the 1970s and early '80s from DOE's now-closed Rocky Flats nuclear weapons component manufacturing plant, located near Denver, Colo.

"The tremendous accomplishments made at AMWTP have enabled DOE to be nearly three years ahead of the legally binding schedule we have with the state of Idaho," said Jim Cooper, DOE's acting deputy manager for the Idaho Cleanup Project. "This project is delivering on DOE's promise to clean up its Idaho Site."

No other project in the country has processed and disposed of as much transuranic radioactive waste during the past five years as AMWTP. The waste shipments from the project account for almost half of all shipments made to DOE's Waste Isolation Pilot Plant, located near Carlsbad, N.M., where transuranic radioactive waste is permanently disposed of. The accomplishment is a credit to AMWTP employees and their strong safety culture.

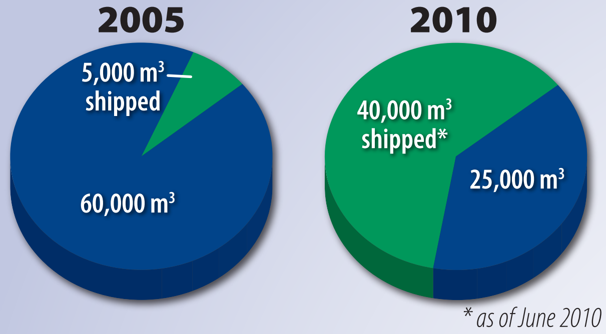
"Our employees are firmly committed to the safe, compliant and efficient operation of this facility and have more than 10.6 million hours worked without a lost-time injury," said Jeff Mousseau, BBWI president and general manager. "Our employees are intent on bolstering this project's reputation for safety at DOE's facility of choice for treating and shipping transuranic waste."

The project's progress prompted DOE to send contact-handled transuranic waste from other DOE locations to AMWTP for treatment and shipment out of state. To date, waste has been received from Nevada Test Site, DOE's Hanford Site, Lawrence Livermore National Laboratory and General Electric Vallecitos Nuclear Center.

"Our employees are intent on continuing to set the standard of excellence for transuranic radioactive waste processing to support cleanup," said Mousseau. "By meeting our production goals, satisfying customer needs and maintaining our low production cost position, AMWTP will continue to be DOE's facility of choice for transuranic waste processing operations."

Idaho Cleanup Project — By the numbers

2005 **2010**

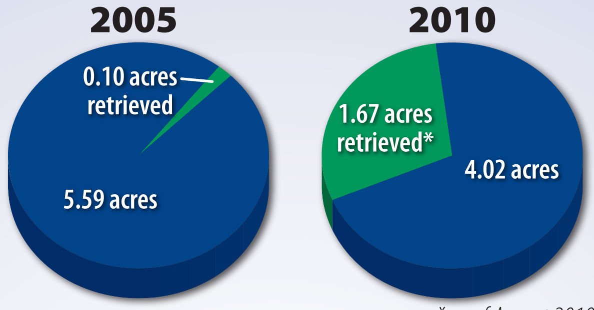


* as of June 2010

Stored transuranic (TRU) waste

- Cubic meters transuranic waste in storage
- Cubic meters of transuranic waste shipped out of state

2005 **2010**



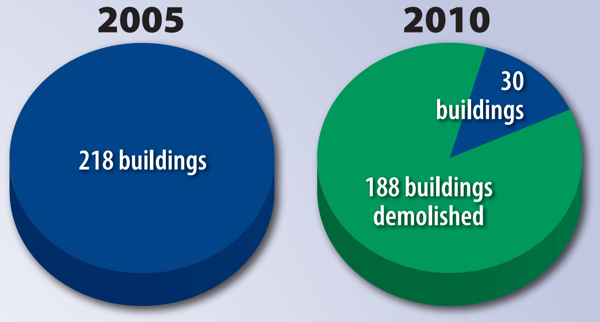
* as of August 2010

Buried waste targeted for retrieval†

- Acres of buried waste to be retrieved by 2025
- Acres of buried waste retrieved

† based on 2008 decision requiring 5.69 acres to be retrieved

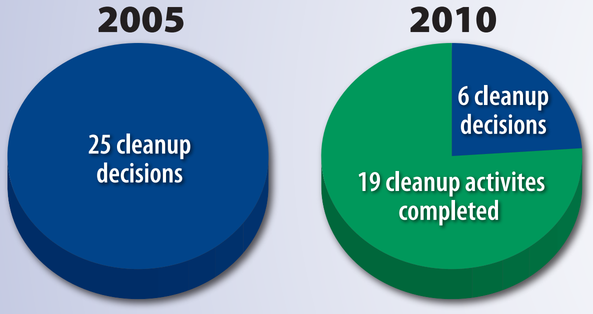
2005 **2010**



Buildings targeted for demolition

- Buildings scheduled for demolition
- Buildings demolished

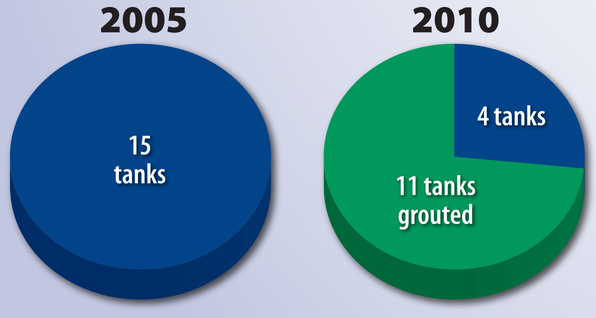
2005 **2010**



Cleanup decisions

- Cleanup decisions (cleanup activities under way)
- Cleanup decisions (cleanup activities completed)

2005 **2010**

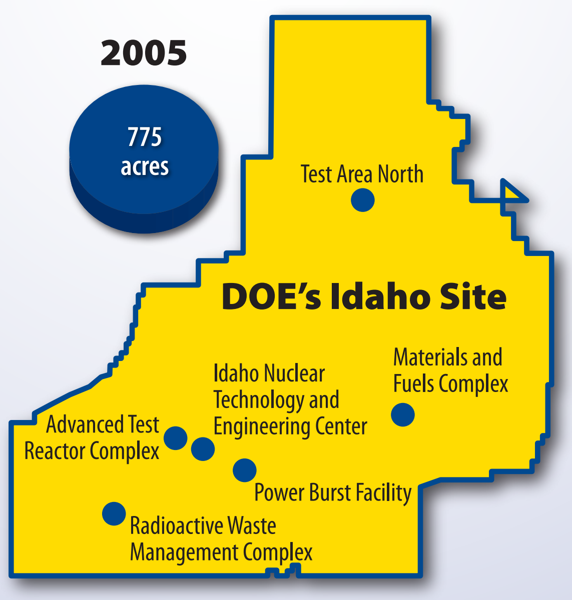


Tanks at INTEC Tank Farm targeted for grouting

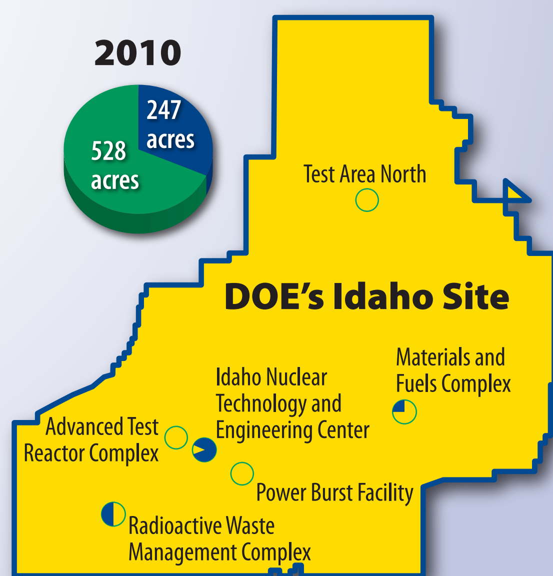
- Tanks ready for grouting
- Tanks grouted

Footprint Reduction at DOE's Idaho Site

2005



2010



The search for greener energy

"If green energy existed and was at the scale we needed, the world would be using it and there would be no need for energy research," said Dr. David Hill, deputy laboratory director for Science & Technology at INL. "However, every energy technology we have today has environmental impacts and limitations. It is the reason why energy is the number one issue facing the world.

"INL's challenge is to improve existing technologies and make them greener while aiming for long-term sustainability and security for our nation and the world. It's a challenge that requires science, engineering and, most definitely, public policy."

Countries without hydrocarbon reserves depend on nuclear energy to provide reliable baseload electricity — electricity that is always on. Nuclear energy supplies 75 percent of the France's electricity needs and 52 percent of Belgium's electricity needs, a demonstration of nuclear power's strength as a baseload energy source.

The U.S. has more options for filling its energy needs, the largest coal reserves in the world as well as oil, natural gas and significant renewable energy resources. Given the range of options, what is the right balance for long-term energy sustainability and security? It depends.

Balancing the range of options drives INL's energy research mission. INL is exploring nearly every form of energy technology, not just nuclear, but also geothermal, wind, hydropower, biofuels and fossil, as well as conservation.

Advancing carbon-free technologies

Baseload energy sources present technical challenges, such as how to handle the waste. One of the waste challenges associated with fossil energy use is greenhouse gas emissions.

"Until recently, the solution was to let carbon dioxide and other gases disperse into the air," said Hill. "However, with greenhouse gases beginning to impact the atmospheric and political climates, there is a growing worldwide interest in nuclear energy as a carbon-free option."

Nuclear waste — the used fuel from a reactor — is the opposite. Instead of being globally dispersed, it is highly concentrated, radioactive and hazardous.

"There are distinct advantages to having a compact waste; it can be managed with simple technologies and materials like concrete, lead and steel," said Hill. "The challenges are location and time. We need to secure storage for long time frames, or develop a viable form of nuclear fuel recycling, or some combination of both. Finding improved solutions to nuclear waste management is one of our ongoing nuclear research projects."

Dr. David Hill, deputy laboratory director for Science & Technology, is an internationally recognized expert on nuclear reactor and fuel cycle issues.

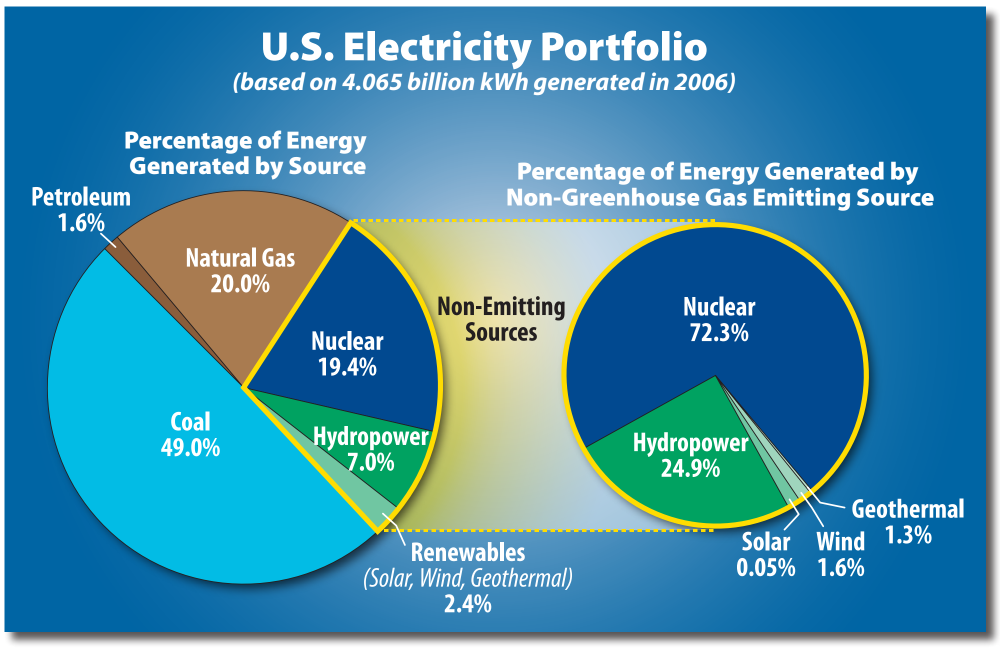
Extending long-term nuclear operations

Commercial nuclear reactors in the U.S. were initially licensed to operate for a conservative 40-year period. This was a legal limit, not a technical limit. Because these reactors have been proven to be durable, their licenses have been, or are being, extended to 60 years.

Much of INL's nuclear research is focused on identifying performance limitations so that measures can be developed to extend reactor life.

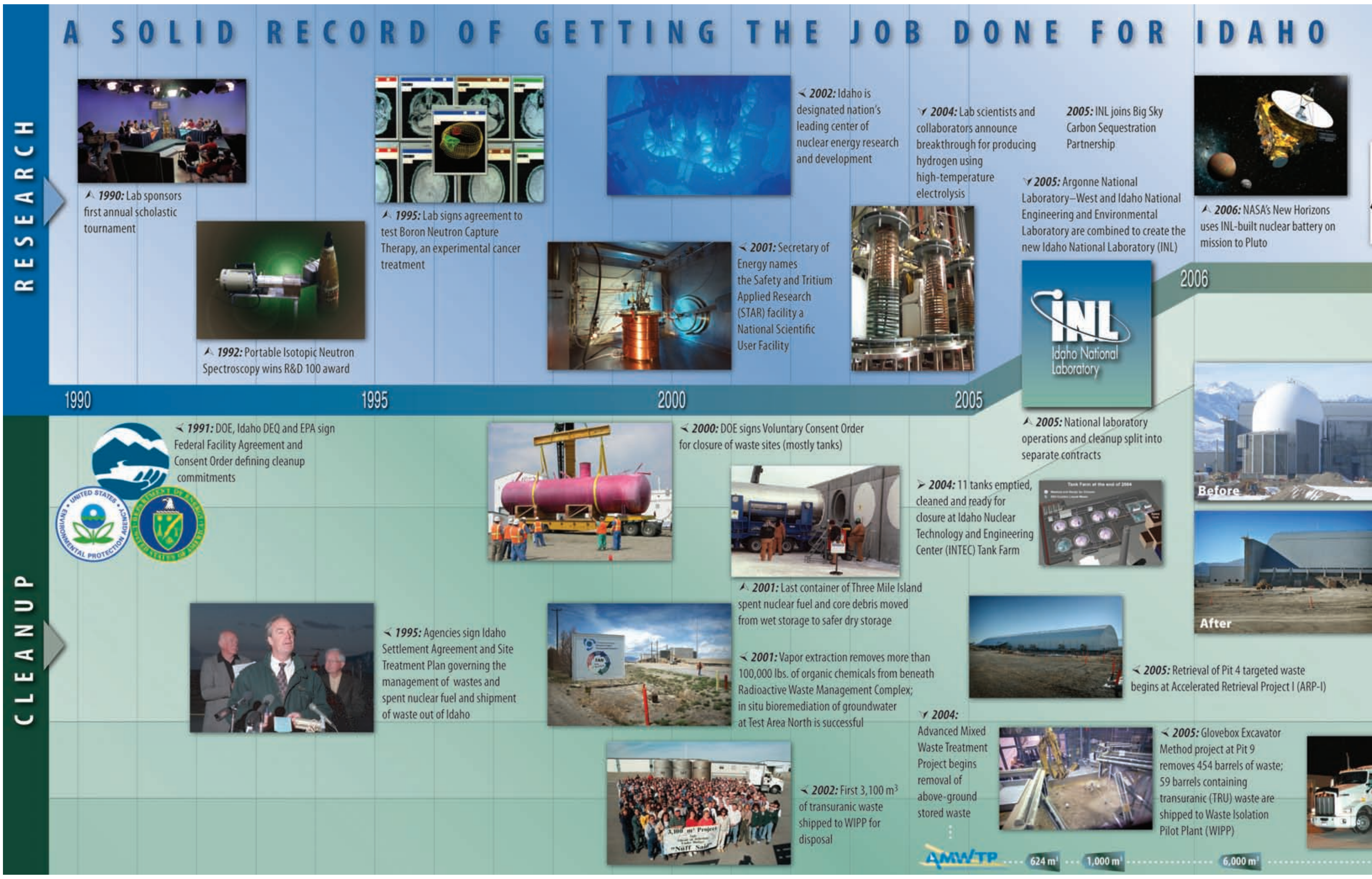
"We are proud of all the energy research we do, but INL's strength has always been in nuclear energy research," said Hill. "It dominates our research portfolio. The nation and world rely on our nuclear expertise."

Recent estimates show that nuclear energy is capable of generating the greatest net reduction in greenhouse gases.



Fuel recycling — the key to renewable nuclear energy

In a typical "once-through" nuclear power reactor, less than 1 percent of the uranium is consumed because by-products build up in the fuel and steadily reduce the reaction's efficiency. If we can remove the by-products, nuclear fuel can be recycled. INL researchers are working on these challenges — improving recycling technologies and fuel efficiency and reducing concerns related to misuse.



Idaho Cleanup Project – Preparing the site for new missions

Over the past two decades, DOE has made significant progress removing legacy facilities and cleaning up contamination at their Idaho Site. During that time, the federal government has invested nearly $9 billion toward cleanup and waste management. Cleanup involves removing nuclear reactors, eliminating high-hazard facilities and removing buried waste and contaminated soil.

Importantly, DOE is keeping its commitments and consistently meeting enforceable milestones to ship waste out of state, retrieve buried waste and clean up sites contaminated by past activities.

At the urging of stakeholders and regulators, DOE prioritized cleanup and waste management activities to maximize the reduction of risk to workers, the environment and the public. As a result, the contractors who conduct the cleanup mission at DOE's Idaho Site have made great progress eliminating potential contamination threats to the Snake River Plain Aquifer and removing high-hazard facilities.

Since the 2005 separation of cleanup scope from laboratory operations, the Idaho Cleanup Project (ICP) has successfully moved all DOE-owned spent nuclear fuel from wet to dry storage and removed and safely disposed of four nuclear reactors — the Loss of Fluid Test reactor, Engineering Test Reactor, Power Burst Facility reactor and Zero Power Physics Reactor — as well as the Test Area North hot shop. ICP has also made significant progress on the removal of two other reactors — the Materials Testing Reactor and Experimental Breeder Reactor-II. Our cleanup contractors have done an impressive job staying on schedule and significantly under budget.

In 2007, at the Idaho Nuclear Technology and Engineering Center, 11 of 15 high-level waste tanks were emptied, cleaned and grouted. To meet DOE's commitment to the state of Idaho, the liquid waste that remains in the tank farm must be treated by the end of 2012. Treatment will take place at the nearly completed Sodium Bearing Waste Treatment Project, a $570 million treatment facility designed to turn 900,000 gallons of sodium-bearing liquid waste into a stable granular material ready for permanent disposal.

With respect to managing waste, site contractors have exhumed more than one-third of the buried waste targeted for retrieval. Site contractors also have excavated and shipped substantial quantities of waste out of state and are steadily reducing the site footprint, which reduces our ongoing management costs.

The best way to see the progress we have made is to look at the cleanup statistics. Of the 25 major cleanup decisions identified in the 1991 cleanup agreement with the state of Idaho and EPA, 19 have been fully implemented with all cleanup and control activities completed. These completed actions undergo monitoring every five years to confirm their effectiveness. The remaining six cleanup efforts are substantially under way. Our other statistical measures of cleanup success are reflected in the volume of waste shipped, acres of waste exhumed, footprint reduced and number of buildings demolished. *(See Idaho Cleanup Project — By the numbers on page 3.)*

The Advanced Mixed Waste Treatment Project has processed and shipped more transuranic waste out of Idaho than any other site in the DOE complex. Idaho waste currently accounts for more than 45 percent of the waste permanently disposed of at the Waste Isolation Pilot Plant near Carlsbad, N.M.

We hope our cleanup accomplishments will continue to earn public trust, confidence and support for INL's ongoing research and development missions. A visit to DOE's Idaho Site clearly shows the progress; the contrast between 20 years ago and today is striking. Where buildings once stood, you will see level earth.

We encourage all stakeholders to learn about the cleanup progress, ask tough questions and continue holding us accountable for our environmental practices. As the site manager, my commitment to you is to continue meeting our cleanup obligations so we retain our position as one of the forerunners in environmental management in the DOE complex.

Cleanup activities and removal of large facilities have dramatically reduced the footprint of DOE's Idaho Site.

Rick Provencher was named DOE-Idaho Site manager in May 2010. Previously, he served six years managing DOE-Idaho's Environmental Management programs, overseeing all waste management and site cleanup activities.

As manager of the Idaho Operations Office, Provencher oversees 280 federal employees and 6,500 contractor staff who work at INL and carry out environmental cleanup and waste management at the INL Site. Provencher also is responsible for an annual federal and contractor budget that exceeds $1 billion.

Combining technologies to improve efficiency

The concept of a hybrid car is simple; combining technologies helps capture energy that is otherwise lost. The hybrid system is cleaner and more energy-efficient.

Researchers at INL are applying the same logic to industrial power and manufacturing plants. By mixing and matching different energy sources, they can create hybrid plants that are "greener" and more efficient.

"Energy is delivered in several distinct forms, as electricity in our homes and businesses, as liquid fuels for transportation and as process heat for industrial applications," explained Dr. Steven Aumeier, director of Energy Systems and Technologies for INL. "With the right engineering, combinations of energy sources, industrial processes and raw materials can be more efficient collectively than they are separately, while also reducing emissions. Instead of saving a tank of gas, we could save several hundred trainloads of coal. This is a fast-growing research area for INL and a smarter way to produce energy and products."

Leveraging energy sources

One of the driving ideas behind combined systems is the opportunity to leverage renewable energy sources. Solar and wind power, for example, are intermittent.

"They don't always produce energy in sync with demand," said Aumeier. "Combining renewable energy sources with industrial processes and raw materials like carbon will allow us to store that energy in other forms, perhaps as a liquid fuel or a value-added product. The point is to store the energy for later use."

Nuclear energy has a significant role in hybrid energy systems. Besides providing baseload electricity, it could provide the process heat required for generating industrial hydrogen or other products.

A hybrid system that combines nuclear and renewable energy sources could convert carbon sources and excess energy into energy products, such as transportation fuel or value-added industrial chemicals. These systems could be the economic drivers for more efficient resource use in our energy-rich region.

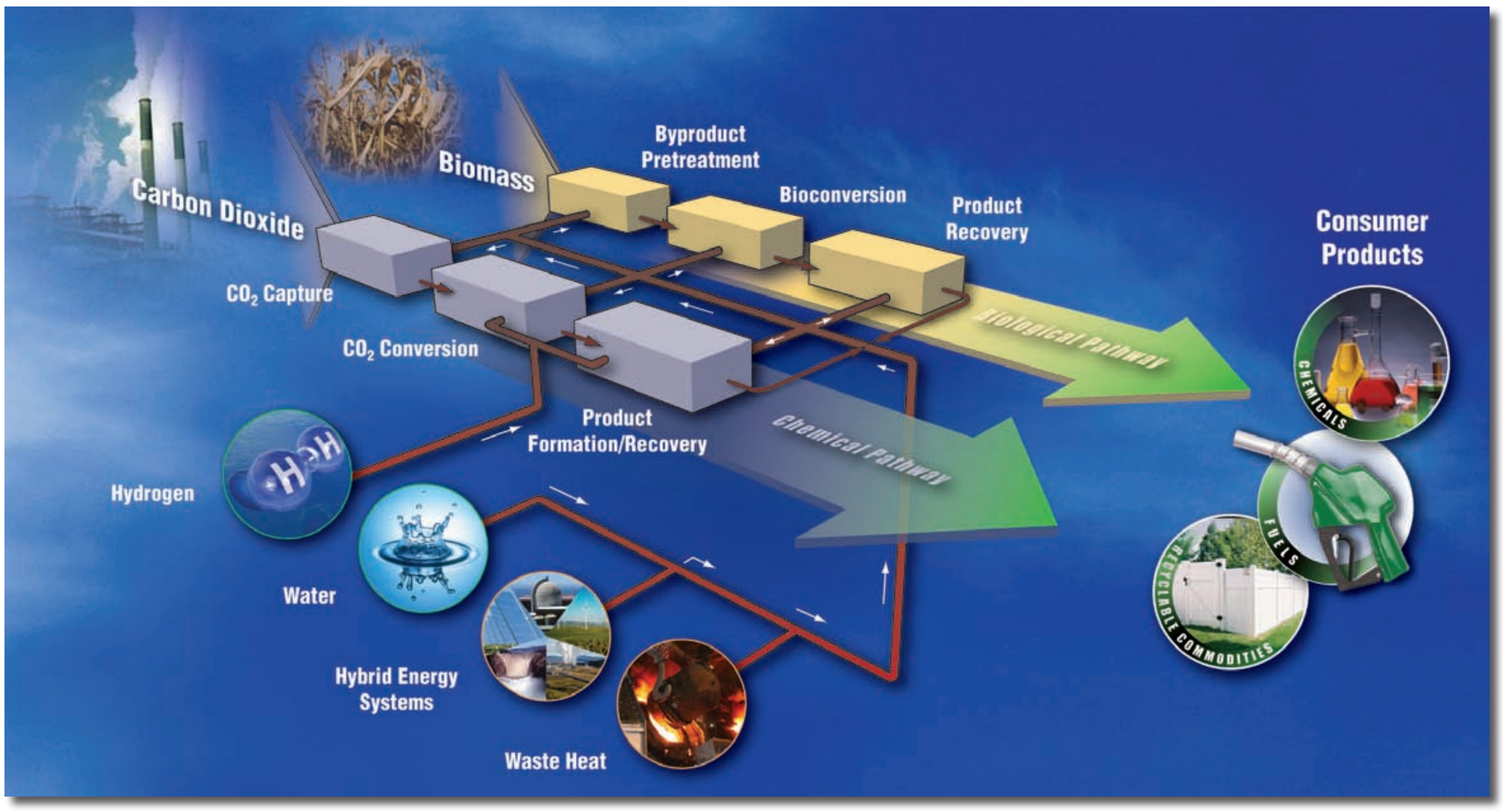
The key to hybrid energy research is having an eye for unconventional opportunities. For example, a well-designed hybrid energy system could convert biomass into biodiesel. Or, instead of burning coal to produce electricity, a hybrid energy system could convert it into liquid transportation fuels or other valuable chemical products that might result in greater energy efficiency and lower emissions.

INL has three laboratory facilities dedicated to hybrid energy system research and is proposing to build a new $30 million, 85,000-square-foot facility. INL's researchers are developing combinations that might work together more efficiently. Integrating two or more power/industrial plants into one facility is a massive applied engineering problem that is perfect for INL.

"INL has a great track record of proving the principle and helping industry take new ideas to reality," said Aumeier. "Think about all the prototype nuclear reactors built in Idaho over the last 60 years and the impact this technology has had in providing 15 percent of the world's electricity. My hope is that we have the same success with hybrid energy systems."

INL has several research laboratories that support the development of hybrid energy systems and associated technologies.

A combination of energy sources, industrial processes and raw materials can be more efficient collectively and a smarter way to produce energy and products.



Biofuels research at INL is focused on turning plant materials into a biomass energy source.

Energy from plant residues

As a natural resource, biomass is plentiful. It includes agricultural residues, energy crops and woody materials that do not make it into lumber or paper products, by-products and leftovers from commercial food production and municipal waste. Biomass contains significant energy in the form of sugars that can be converted to ethanol and other fuel components, as well as significant potential energy locked up in the cellulosic material.

"Can we use biomass energy to wean us off foreign oil?" said Richard Hess, Biofuels and Renewable Energy Technologies manager for INL. "Not by itself. But making better use of biomass resources is an important step toward greater energy independence."

It's very appealing to think of plant waste as a biomass energy source rather than a disposal problem, but the economics quickly get tricky. Spending too much energy and money harvesting, storing, preprocessing and transporting the plant waste cancels its value as a fuel. While these issues seem problematic, biomass refineries have great potential for integration into hybrid energy models.

INL's research goal is to improve the cost-effectiveness of bioenergy systems by focusing on key technical barriers facing the U.S. bioenergy industry.

ENDURING ENVIRONMENTAL SOLUTIONS

Nuclear chemistry leads to oil spill cleanup

Solving the energy crisis, enabling an environmentally sustainable future and creating better medicines — these are three of the 14 most-pressing challenges society faces, according to the National Academy of Engineering. A patented centrifugal separation technology developed by INL chemist David Meikrantz addresses these three grand challenges.

The story began 20 years ago when Meikrantz was working in nuclear energy. Like others at INL, he was looking for a better way to separate materials in nuclear fuel because separating by-products from the fuel component could help solve one of the biggest challenges of nuclear fuel recycling. Meikrantz's approach involved using centrifuge-based separation technologies.

"We use centrifuges to concentrate uranium isotopes," said Meikrantz. "So, why not apply a similar approach to recover nuclear material?"

After spending his early career developing chemical separations processes, Meikrantz found other ways to apply his ideas. One of these was an environmental cleanup application. Seeing the disaster from the Exxon Valdez spill, he adapted his nuclear technology to separate oil from seawater and patented the approach in 1990. The patent was purchased in 1993 by a business owned by actor and venture capitalist Kevin Costner. Meikrantz joined Costner Industries Nevada Corporation in 1994 as the company's technology director. The relationship prompted yet another spinoff company, Ocean Therapy Solutions, whose oil-water centrifugal separators were used this summer to help clean up the Deepwater Horizon oil spill.

Meikrantz returned to INL and his nuclear roots in 2003. This time, his target was separating medical isotopes for cancer treatment. He developed another innovative technology, Medical Actinium for Therapeutic Treatment, which was nominated for an R&D 100 award in 2006 and later licensed to a nuclear pharmaceutical company.

"Sometimes my work is for nuclear energy, sometimes for cancer treatment," said Meikrantz. "This year, it is best known for oil spill cleanup. That's okay with me."

The oil-water separators that BP is using to help clean up the recent Gulf oil spill were invented by INL chemist David Meikrantz.

Putting carbon dioxide to bed(rock)

"Locking up" carbon dioxide (CO_2) in rocks is one solution for managing greenhouse gases. The solution, called carbon capture and sequestration, involves pumping the gas deep underground.

INL researchers Rob Podgorney and Travis McLing are working with regional universities, corporations and international partnerships based in Iceland and Holland to study how CO_2 interacts with rock formations and eventually forms harmless minerals, a process called mineral sequestration.

Through the Big Sky Carbon Sequestration Partnership, launched in 2005, they have modeled, simulated and studied how CO_2 interacts with the basalt underlying the Snake River Plain.

According to Podgorney, deeply injected gas should mineralize within a decade or two, long before it has a chance to escape into the atmosphere or overlying aquifers. In Phase III, the Partnership plans to inject three million tons of CO_2 into a sedimentary basin in north-central Montana over a three-year period.

The INL team is also working to analyze the geochemistry of a naturally carbonated spring in Soda Springs, Idaho. McLing is developing mineralization tracers to learn how CO_2-infused water moves in the basalt and other target formations. The information will help improve the reliability of team's models and simulations.

Earlier this year, the INL team traveled to Iceland for the launch of CarbFix, the world's first large-scale test study of mineral sequestration in basalt and a collaborative effort led by the University of Iceland, Columbia University, Reykjavik Energy and France's National Center for Scientific Research. While they were in Iceland, the team met with the country's president and scientists.

The team's efforts have shown that while carbon capture and sequestration is a viable option, the economics are daunting.

"Scrubbing CO_2 from smokestacks, processing it and transporting it to injection sites would take up about 25 percent of a typical coal-fired plant's energy output," said McLing. "So for every three new plants built with carbon-capture capabilities, a fourth plant would be needed for capture and sequestration.

"Unless there is a government-imposed price on CO_2, likely somewhere between \$50 and \$100 per ton, carbon capture and sequestration is economically impractical. The cost would be paid by the industrial plants, but they would pass it on to consumers."

Rock samples are examined at a Center for Advanced Energy Studies laboratory to verify carbon dioxide is captured as carbonate minerals.

INL researchers have successfully demonstrated the potential to sequester or "lock up" carbon dioxide in basalt rock formations.

Discussion with INL director … Continued from page 1

our renewable energy resources, but I think it is equally clear the world needs nuclear energy. It does not emit carbon and has a proven record for reliability and capacity.

Can we make nuclear energy better? Absolutely, but it is a robust technology right now, can support growing global demand, and its costs, risks and environmental impacts are competitive with other energy resources.

On the role of technology in sustainable development

People often adopt technologies and practices that are unsustainable, but it isn't because they don't care about the future. It's because those options appear cheaper in the short run. Longer-term costs can be difficult to understand and are less certain so they're harder to factor into our decisions.

Sustainability requires a long-term view, a respect for economic realities, a disciplined allocation of scarce resources and a valuation of the impacts on current as well as future generations. Taking all these things into account, sustainable practices may be less expensive in the long term.

Our challenge is to navigate from where we are now to where we need to be in the future. The requirements are that we must meet people's expectations for a reasonable quality of life with limited resources, the burden of infrastructure and the associated economic and environmental costs.

Fossil fuels will be with us for a long time. As liquid transportation fuels for aircraft and heavy transport, they are hard to beat. They are also the raw materials for the many petrochemical products — paints to plastics — on which we rely. However, the long-term use of fossil fuels to generate electricity will largely depend on the costs, risks and environmental impacts of carbon capture and storage.

Renewables should be used as much as possible to the extent they are economically reasonable, but they have some serious limitations because they are distributed and intermittent. Also, like all energy sources, renewables have associated costs, risks and environmental impacts.

Whether it is used to generate electricity or as a replacement heat source for industrial processes, nuclear energy is sustainable for a very long time. Its costs, risks and environmental impacts are competitive, both short term and long term.

On energy security

Energy security is not just about resource availability. It's about confidence in having access to the energy resources we need at fair and reasonably stable prices. The economic aspect is important to the competitiveness of our businesses and economy.

On worker safety

World-leading safety, environmental stewardship, taking care of our people and mission accomplishment are all equally important to us at INL. Safety is about taking care of our people at a very fundamental and important level. If an employee gets hurt on the job or at home, it is a loss. Our emphasis on safety — all day, every day — is one of INL's core values.

On energy efficiency

U.S. taxpayers own INL, so we have a responsibility to be good stewards of their trust and resources. It is part of our job to set a good example and use energy wisely and efficiently.

Our existing facilities are being modified to support our work more efficiently in terms of energy use and our new buildings aim for high standards of sustainability. Our INL bus fleet, which is our mass transit system, allows us to transport our employees safely and with greater fuel efficiency.

In the future, I would like to see a fleet of hybrid buses and other investments at the laboratory that make us world leaders in energy efficiency and sustainable practices.

Sagebrush Steppe Ecosystem Reserve & National Environmental Research Park

A culture of preservation

Protecting and studying natural resources

Across the West, about 1 percent of the historic sagebrush steppe ecosystem remains relatively unchanged from its condition prior to European settlement. Perhaps the largest, mostly undisturbed remnant of the sagebrush steppe ecosystem is at the 890-square-mile INL Site, which has been withdrawn from public use since the 1950s.

In 1975, the INL Site was designated as a National Environmental Research Park in response to recommendations from citizens, scientists and members of Congress to set aside land-buffering DOE facilities for ecosystem preservation and study. These lands offer unique opportunities for research and education while demonstrating the compatibility of energy research with the environment.

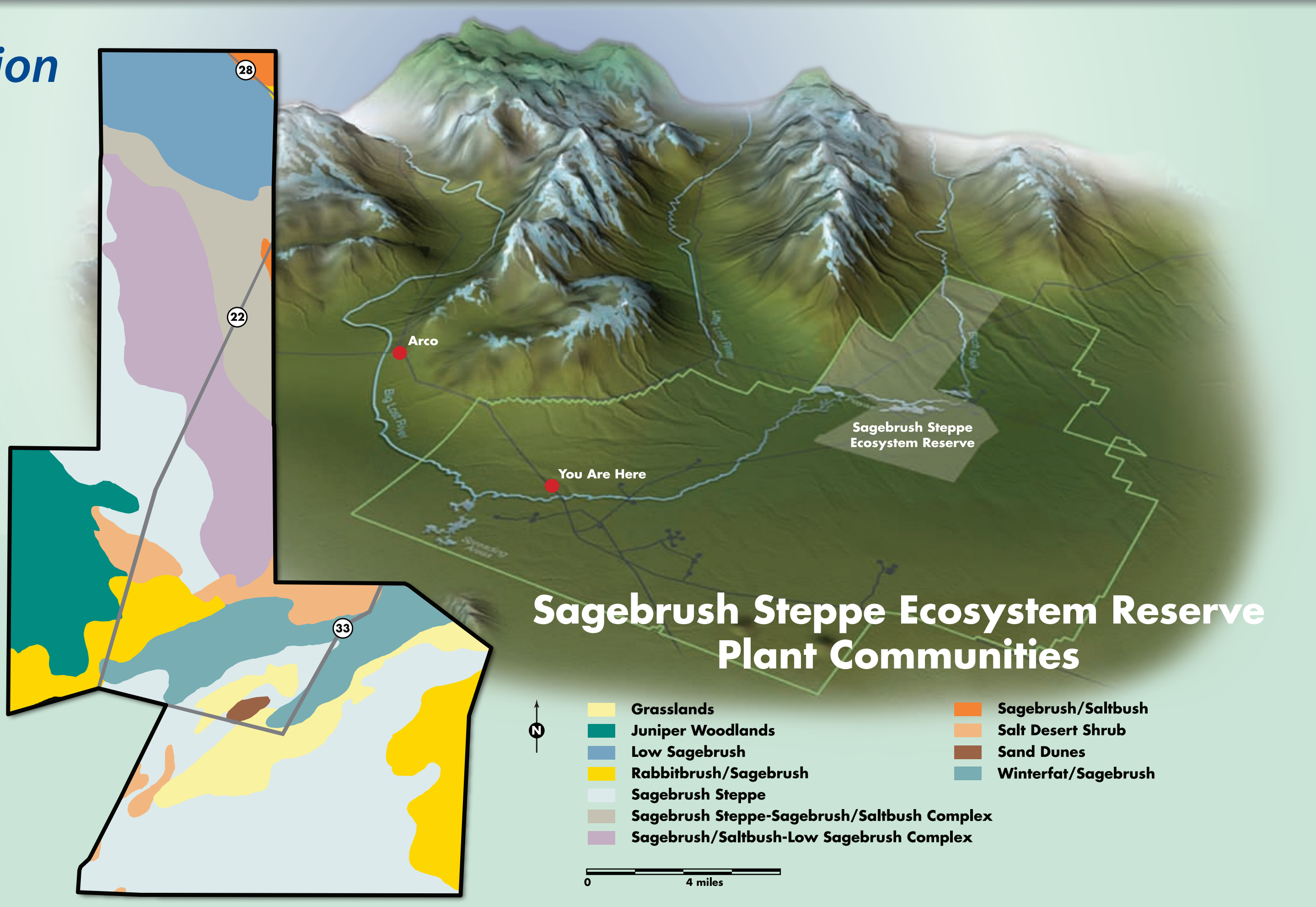
In 1999, the U.S. Secretary of Energy further designated 114 square miles of the INL Site as a Sagebrush Steppe Ecosystem Reserve to "… maintain the current plant community and provide the opportunity for study of an undisturbed sagebrush steppe ecosystem…"

For the past decade, both the research park and the ecosystem reserve have been managed by the Environmental Surveillance, Education and Research (ESER) program, operated by the S.M. Stoller Corporation. The ESER team facilitates a wide variety of research and education programs separate from DOE's cleanup and national laboratory missions, including wildlife habitat and vegetation surveys, sitewide research concerning threatened species, pollutants in the environment and revegetation.

"The site provides a rich environment for training researchers and introducing students from grade school to graduate school in the ecological sciences," said Roger Blew, Ph.D. ecologist for ESER and National Environmental Research Park coordinator. ESER helps direct research funding to local, regional and national universities. "More than 80 graduate students have conducted their thesis or dissertation research here," said Blew.

Ecological research at the park is leading to better land-use planning, identifying sensitive areas so that restoration and other activities are compatible with ecosystem protection and management and increasing contributions to ecological science.

"A major goal of our program is to assist DOE with conservation management," said Blew. "Better understanding of the natural environment leads to better environmental decisions."



The entire INL Site is considered a National Environmental Research Park with the northern portion designated as the Sagebrush Steppe Ecosystem Reserve.

Amy Forman, ESER plant ecologist with S.M. Stoller Corporation, trains a group of field technicians to measure plant cover as part of an effort to describe habitat characteristics for sage grouse and pygmy rabbit at the Idaho National Environmental Research Park. DOE will use this information to develop conservation strategies for these two species.

Idaho Department of Fish and Game employees help an Idaho State University graduate student place a radio collar on a cow elk at the Idaho National Environmental Research Park. DOE uses research information like this to support conservation planning efforts.

After the Power Burst Facility reactor was removed, the area was graded and reseeded with native plant species as recommended by the ESER program. Learning about ecosystems helps DOE better restore the environment.

ESER manages the Idaho National Environmental Research Park to meet five objectives:

- Develop methods for assessing and documenting the environmental consequences of human actions related to energy development
- Develop methods for predicting the environmental consequences of ongoing and proposed energy development
- Explore methods for eliminating or minimizing predicted adverse effects from various energy development activities on the environment
- Train people in ecological and environmental sciences
- Support public education on environmental and ecological issues.

FOR MORE INFORMATION

One of Idaho's largest employers, INL is home to more than 4,000 scientists, engineers, administrators and support staff. Whether you are an experienced professional at the top of your field or recent graduate looking for an entry-level position, INL may have a job for you.

Idaho National Laboratory
- www.inl.gov

Idaho Cleanup Project
- idahocleanupproject.com
- amwtp.inl.gov

Environmental Surveillance, Education and Research
- www.stoller-eser.com

U.S. Department of Energy-Idaho Operations Office
- www.id.doe.gov

Idaho Department of Environmental Quality INL Oversight
- www.deq.idaho.gov/inl_oversight